Biogas produktion i økologisk landbrug. Samfundsøkonomisk analyse

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BioConcens: Biogas Socio-economy

Biomass and bioenergy production in **o**rganic agriculture – **con**sequen**c**es for soil fertility, **en**vironment, spread of animal parasites and **s**ocio-economy.

Biogas produktion i økologisk landbrug

Samfunds-økonomisk analyse

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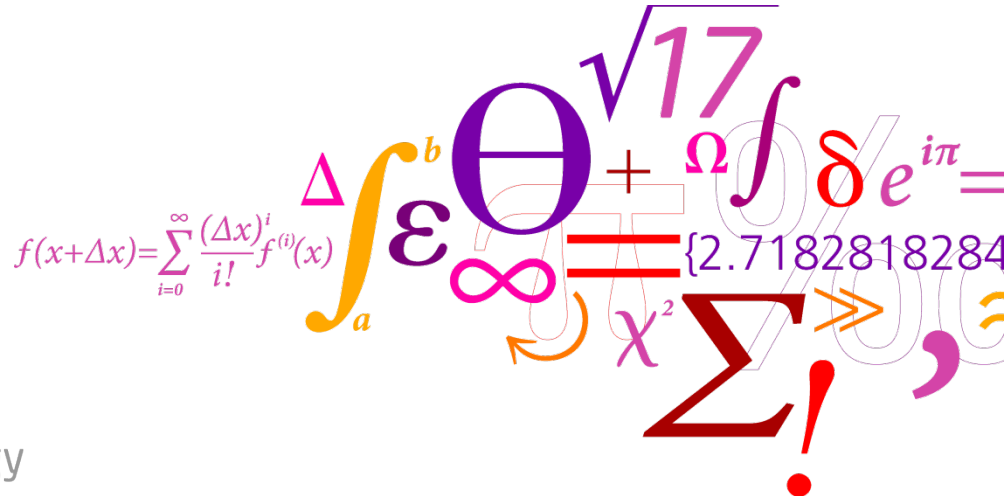


Risø DTU

National Laboratory for Sustainable Energy

Første møde i følgegruppe relateret til "økologisk" biogasproduktion

- ***Biogasanlæg, drevet primært på basis af Grønbiomasse***

- *Hovedresultaterne af udregningerne på samfundsøkonomien for anlæggene og videre – hvordan anvender man optimalt biogas i økologisk produktion –*

  gårdanlæg eller fællesanlæg?

  Hvor mangler der viden?

Seniorforsker, Lars Henrik Nielsen, Risø – DTU.

”økologisk” biogasproduktion
primært på grønbiomasse

Erhvervet peger på **fordele** i form af

- **mindre klimabelastning,**
- **bedre næringsstofudnyttelse,**
- **øget højværdiproduktion,**
- **optimeret sædskifte** og ikke mindst
- **afgasset grønbiomasse** som **vektor for øget omlægning til økologi** i egne med begrænset adgang til husdyrgødning.

Dele af erhvervet ser endvidere anlæggene som **midlet til**

- **øget uafhængighed af gødning fra konventionelt landbrug**.

Udfordringer:

- **utilstrækkelig gasproduktion**,
- **høje omkostninger**

og deraf følgende dårlig økonomi i anlæggene er en udfordring
for danske biogasanlæg baseret på grøn biomasse.

Indhold

- Samfundsøkonomisk metode (≠ selskabs-økonomi)
- Biogas: Hvad medregnes i en samfundsøkonomisk analyse
- Generelle forudsætninger
- Scenarier i BioConcens
- Resultater
- Diskussion: Vigtige faktorer og usikkerheder

Method

socio-economy including externalities

- **Difference analysis (cost benefit)**
  Difference = Alternative – Reference

- **Key numbers focussed on:**
  - Socio-economy (**relative to defined reference organic agriculture**)
  - Energy-balance
    Energy-autonomy
  - CO_2 –eq. emission
  - CO_2 –eq. emission reduction cost
  - …

- **Inputs**
  - What has been impacted: **Any kind of 'relevant' effect of the alternative!**
  - Quantification: **To what extents**
  - **Monetisation:** **Related costs and benefits**
    - **Some effects are reflected in market prices**
    - **and some are not..**

Externalities..

    - With very few data:
      Does the impact have a positive or negative effect for society

Market prices and externalities

Externalities: Socio-economic costs and benefits
not reflected in market prices

"Socio-economic price" = Market price + External costs / benefits

Methods for monetising external effects:

- **Preference-based methods**
  E.g. via virtual markets that reveal market-preferences
  (Interview investigations: How much will people pay to avoid an external effect.)
  Theoretical preferable. However, data often not available.
- **Cost-based methods**
  Focus on damage costs due to the external effect.
  (Repair of damage, loss of production value, medical costs et.c.)
  May not reveal all external costs.

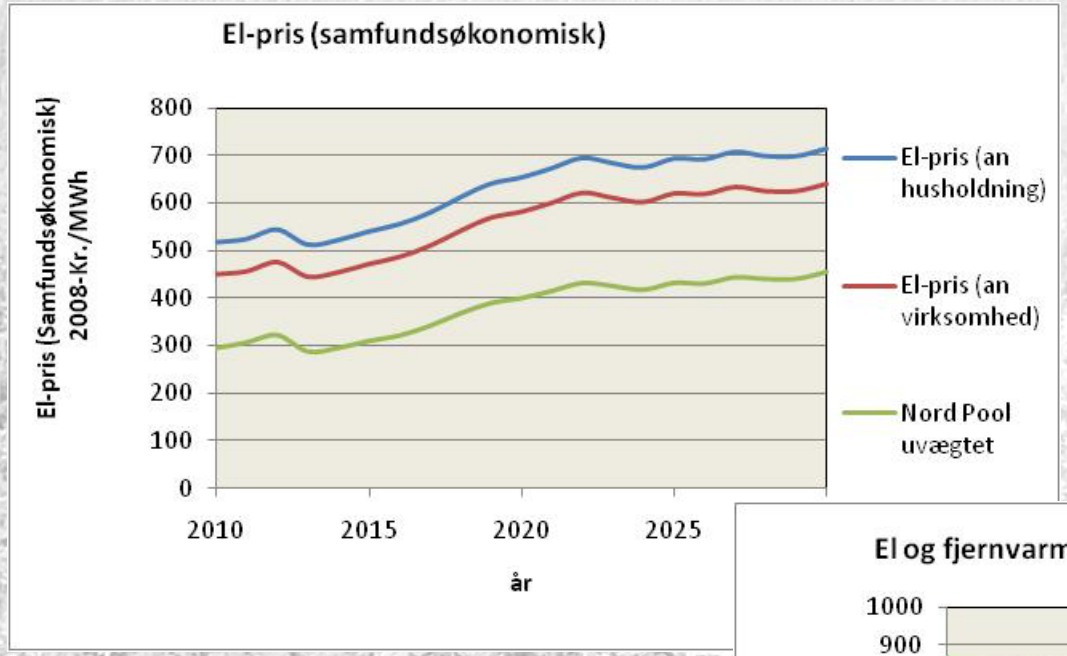
Monetising via: Costs for avoiding / removing the negative external effect

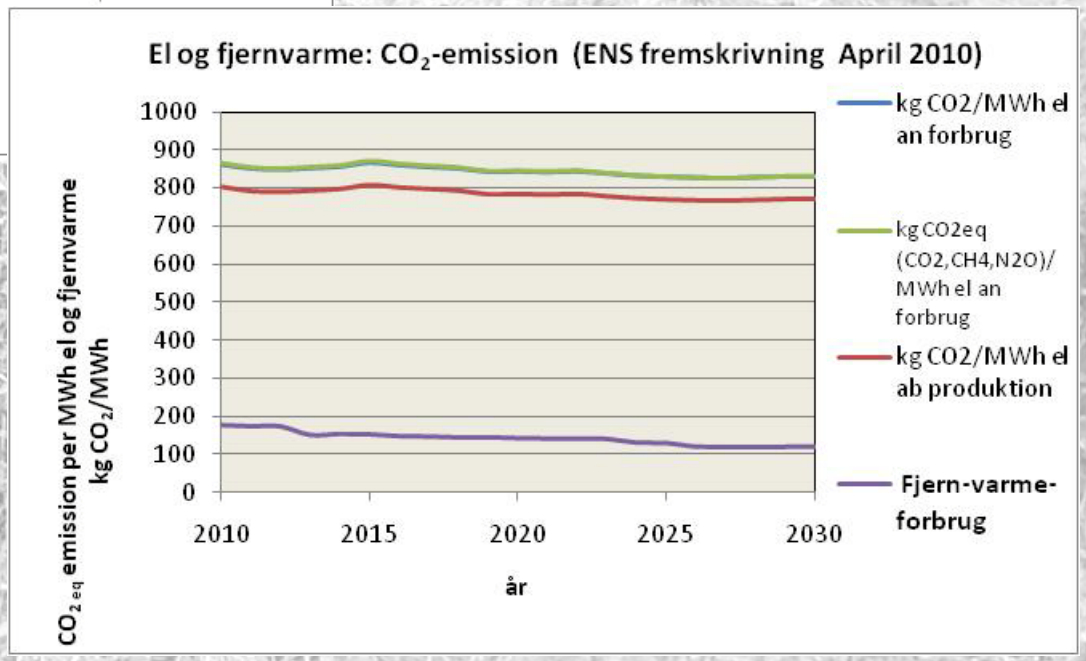
Basis socio-economic assumptions

- Rate of interest: 5% p.a.
- Base year: Year 2010
- Period analysed: Year 2011-2030
  Time horizon year 2030
- Terminal values: Via annuity until time horizon.
- Re-investments: Identical re-investments at life times below time horizon.
- Price level: Fixed year 2008 price level.
  (Ex. tax, subsidies et.c.)

- Fuel prices: Danish Energy Agency forecasts, 2010.

El fra DK net : Pris og CO2-emission





Green House Gasses included

IPCC-defined GHGs and GWP cf. 2. Assessment Report (SAR) :

- **CO_2 GWP_{100}= 1 (weight based)**
- **CH_4 GWP_{100}= 21**
- **N_2O GWP_{100}= 310**

GWP_{100}: Global Warming Potential covering 100 years

Other GHGs are not important in relation to biogas plants

Quantify changed emission of:

Carbon dioxide, methane and laughing gas due to the biogas alternatives

Value of GHG emission reduction:

National Quotas

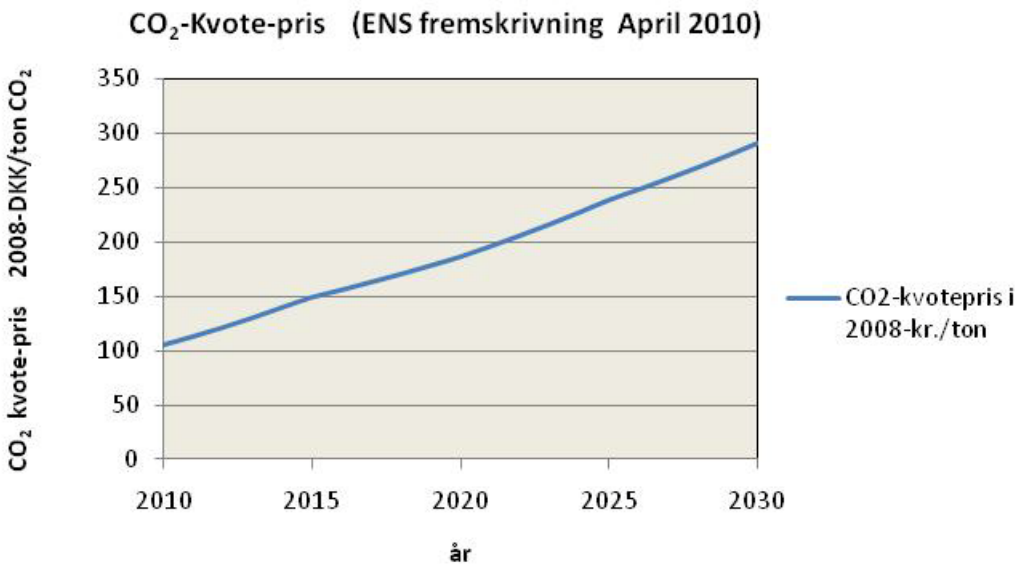
Market for CO2 emission allowances:

NordPool (CO_2 emission allowance)

The present analysis :

Danish Energy Agency

Forecast from April 2010

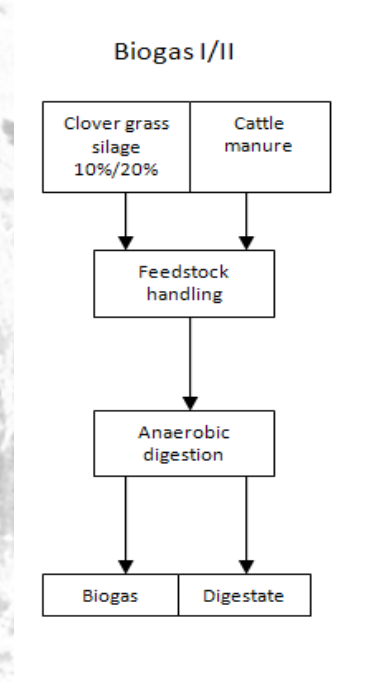


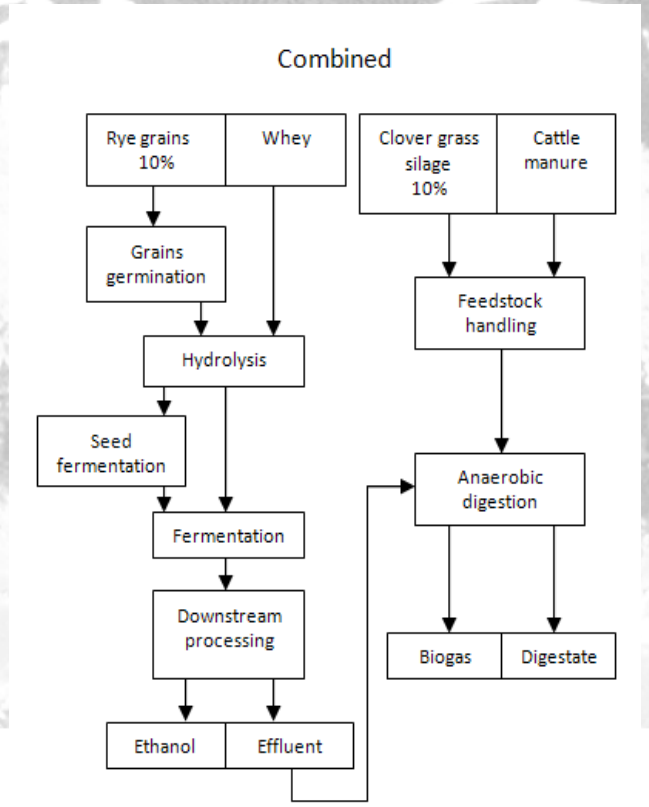
Baseline compared to 3 scenarios named:

Biogas I & **II** and **Combined**(Biogas & Ethanol)

Centralised plants, each to serve 1000 Ha organic farming

	Baseline	Biogas I	Biogas II	Combined	
	1000 Ha	10% grass clover	20 % grass clover	10 % winterrye + whey, 10 % grassclover	





Biogas / ethanol: Production and conversion

Biogas/ethanol yields:

		Biogas I	Biogas II	Combined
Methane	[MWh/year]	5545	7333	7002
Ethanol	[MWh/year]	0	0	1283

Energy production: Biogas and Ethanol plants

		Biogas I	Biogas II	Combined
Electricity	[MWh/year]	1663	2200	2101
Heat	[MWh/year]	3050	4033	3851
Ethanol	[MWh/year]	0	0	1283
Energy demand for transports	[MWh/year]	-98	-91	-15

Biogas / ethanol: CO_2- Reduction

CO_2 - reduction: Biogas and Ethanol plants		Biogas I	Biogas II	Combined
$CO_{2\,eq}$ substituted replacing DK GRID electricity	[ton $CO_{2\,eq}$ /year]	1405	1858	1774
$CO_{2\,eq}$ substituted replacing district heat	[ton $CO_{2\,eq}$ /year]	373	494	471
$CO_{2\,eq}$ substituted replacing transport fuel	[ton CO_2 /year]	0	0	342
Increased CO2 emissions due to transport	[ton CO_2 /year]	-26	-24	-32
CO_2-balance, biogas plant, scenario A (All heat utilised)	[ton CO_2 /year]	1752	2327	2556
CO_2-balance, biogas plant, scenario B (No heat utilised)	[ton CO_2 /year]	1379	1834	2085

Socio-economic aspects included

Level of analysis Aspects included:	Result 0	Result 1	Result 2	Result 3
Energy and resources				
Value of energy production (heat, electricity)	X	X	X	X
Savings related to the electricity grid	X	X	X	X
Security of energy supply and political stability issues				
Resource savings (energy, nutrients)				
Global balance of trades				
Increased road/infrastructure costs				
Environment				
GHG balances		X	X	X
Other emissions (SO_2, NO_x)				
Change in nitrogen leakage				
Effects on soil fertility				
Value of reduced smells				
Agriculture				
Storage, handling and distribution of liquid manure				
Changes in agricultural system				X
Flexibility gains at farms				
Value fertilizer replacement			X	
Veterinary aspects				
Loss in food sales			X	X
Investments and O&M-costs				
Investments, Bioenergy plant	X	X	X	X
O&M costs for bioenergy plant	X	X	X	X
Investments and O&M for liquid manure transports	X	X	X	X
Other aspects				
Employment effects				
Working environment aspects				

Results of socio-economic analysis

Summary (DRAFT)	Unit: 1000 DKK (2009) / year		
Result	Biogas I (A)	Biogas II (A)	Combined (A)
R0 (plant only)	19	559	-
R1 (CO2 added)	367	1019	-
R2 (loss in food sales)	-1383	-5188	-
R3 (externalities)	-1252	-5482	-

A: All heat produced utilised

Diskussion: Vigtige faktorer og usikkerheder

Økonomien 'i' **Samfundsøkonomi ←→ Selskabsøkonomi**

Dif. i: Energipriser (uden ←→ med) Subsidier, afgifter mm.
Eksternaliteter (med ←→ uden)

Hvor mangler der viden?

Usikkerhed på: ***Gårdanlæg eller fællesanlæg?***

Anlægsinvestering pr. M^3 Anlægs-Antal ←→ Anlægs-Størrelse
Anlægs-Størrelse 1-2000Ha ←→ x Ha

Biogas i **Økologisk ←→ Konventionelt Landbrug**

Afgasser Gylle/gødning/**græs mv.** ←→ Gylle/gødning/**affald ..**
Modtage-gebyr **Tab i indkomst ←→ Gebyr modtages**

Udbytte/Pris 'relativt' (lavere/højere ←→ højere/lavere)